097

411.055

LIBRARY
FISH & WILDLIFE SERVICE
PACIFIC OCEANIC FISHERY
INVESTIGATIONS

PROCEEDINGS OF THE UNITED STATES NATIONAL MUSEUM

issued *by the*

SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 89 Washington: 1940 No. 3097

SEVEN NEW CRAYFISHES OF THE GENUS CAMBARUS FROM FLORIDA, WITH NOTES ON OTHER SPECIES

By Horton H. Hobbs, Jr.

While studying many crayfishes that I have collected in Florida in the last few years, and some that have been collected by others, I have noted several forms that appear to be undescribed, and I have rediscovered the true *Cambarus acherontis* of Lönnberg. The new forms are: *Cambarus pallidus*, *C. lucifugus lucifugus*, *C. lucifugus alachua*, *C. hubbelli*, *C. kilbyi*, *C. rathbunae*, and *C. pictus*. The first three of these inhabit subterranean waters; the remaining four are surface species.

Some time ago I collected two species of the white crayfishes in the underground waters of Alachua County, Fla. Not having Lönnberg's original description of *C. acherontis* at hand, I followed Faxon (1898, p. 645) and assumed that the specimens from Gum Cave, Citrus County, were *C. acherontis*, and I regarded one of these new species collected in Alachua County as a new race of Lönnberg's species. The manuscript in which I described it was sent to the National Museum for publication, where it was referred to Dr. Leonhard Stejneger. I am very grateful to Dr. Stejneger for pointing out the fact that it was only an assumption on Faxon's part that his material, which was from Gum Cave, Citrus County, was *C. acherontis*. Dr. Waldo L. Schmitt, also of the National Museum, then suggested that I seek to obtain specimens of the true *acherontis* from the type locality.

Lönnberg collected his type material, two blind subterranean crayfishes, in 1893 in an underground rivulet about 42 feet below the surface near Lake Brantley, Orange County, approximately 12 miles

north of Orlando, in the same county, and close to the Seminole County line. These he described and figured as a new species, *Cambarus acherontis* (1894b, p. 6). Unfortunately, both of his specimens, which were males, are no longer extant.

Learning from my friend Ralph Harmon that he had seen white crayfishes in Palm Springs, Seminole County, which lies approximately the same distance north of Orlando as Lönnberg's type locality and actually not more than 2 miles from it, I hastened to the place, together with Mr. Harmon and Lewis Marchand. We found more than two score of white crayfishes lying in the algae over the bottom of a pool formed by the spring. This pool (walled-up for swimming purposes)

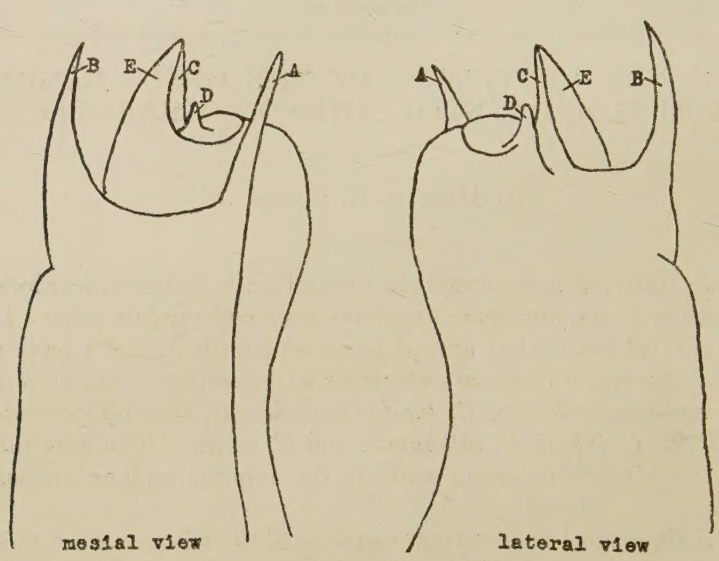

FIGURE 14.—Figure of hypothetical first pleopod of first-form male to illustrate descriptive terminology: *A*, Mesial process; *B*, cephalic process; *C*, centrocaudal process; *D*, caudal process; *E*, centrocephalic process. The so-called central projection of the pleopod is made up of the juxtaposed centrocaudal and centrocephalic processes, *C* and *E*.

measures about 60 by 20 feet; most of it is approximately 6 feet deep. The walls and bottom were covered with a thick algal growth and deposited on it was a sediment characteristic of sulphur springs. The water had a pH of 7.6. Mr. Marchand caught most of the 44 specimens that we secured by diving to the bottom and capturing them with his hands. They were extremely sluggish, many lying in the algae on their backs with their feet turned up toward the surface as though dead. Even after they were bagged there was little sign of life.

Comparing these specimens with the description of *C. acherontis* Lönnberg (1894b, p. 6), I find close agreement with the second-form males, but, judging from Lönnberg's figures 5a and 5b, as well as his

description, I do not believe he had a first-form male before him, but rather that both specimens were of the second form. Faxon's statement (1898, p. 646), "I am therefore inclined to believe that the discrepancies between the Swedish author's account of *C. acherontis* and the specimens before me [from Gum Cave] are due to differences in age and sex, and in part to inaccuracy of description and delineation," is unjust as far as his charge of inaccuracy is concerned. Lönnberg's description is remarkably well done. It is regrettable that Faxon failed to investigate the type locality, that he failed to accept Lönnberg's description at its face value, and that he thus confused two cavernicolous species. Faxon's specimens are identical with *C. lucifugus lucifugus*.

At present two groups of cavernicolous crayfishes are known from Florida, each closely related to surface forms. The first of these groups has only one representative, *C. acherontis* Lönnberg; the other is represented by three forms: *C. pallidus*, *C. lucifugus lucifugus*, *C. lucifugus alachua*.

KEY TO SPECIES OF CAMBARUS REFERRED TO IN THIS PAPER

1. Rostrum with lateral spines or with margins broken 2
   Rostrum without lateral spines, margins smooth 7
2. Albinistic (dorsal surface of abdomen pigmented in some); eyes reduced 3
   Colored; eyes well developed 4
3. Hook on ischiopodite of fourth pereiopod of male simple, not bituberculate 6
   Hook on ischiopodite of fourth pereiopod of male bituberculate ..... **acherontis** (p. 390)
4. Rostrum broadest at base 5
   Rostrum broadest distad of base ..... **lucifugus lucifugus** (p. 398)
5. Pigment spot in eye ..... **lucifugus alachua** (p. 402)
   No pigment spot in eye ..... **pallidus** (p. 394)
6. First pleopod of male with knoblike projection on distal caudolateral margin ..... **pictus** (p. 419)
   First pleopod of male without knoblike projection on distal caudolateral margin ..... **pubescens**
7. Areola moderately broad; chelae subovate 8
   Areola very narrow; chelae strongly compressed dorsoventrally ..... **advena**
8. Inner margin of palm of chelae of males barbate 9
   Inner margin of palm of chelae of males not barbate 10
9. Hooks on ischiopodites of third and fourth pereiopods of male ..... **barbatus**
   Hook on ischiopodites of only the third pereiopods of male ..... **hubbelli** (p. 406)
   Hooks on ischiopodites of third and fourth pereiopods of male ..... **kilbyi** (p. 410)
   Hooks on ischiopodites of only the third pereiopods of male ..... **rathbunae** (p. 414)

Measurements were taken as follows: *Height of carapace*, where cervical groove intersects the middorsal line; *width of carapace*, the greatest width, generally about midway between cervical groove and

posterior margin of carapace; *length of carapace*, measured along middorsal line from tip of rostrum to posterior margin of carapace; *width of rostrum at base*, measured opposite the anterior terminals of postorbital ridges; *length of rostrum*, from the postorbital ridge to tip of rostrum; *length of areola*, measured along middorsal line from cervical groove to posterior margin of carapace; *width of areola*, narrowest place between the sutures; *width of chela*, greatest width of palm.

CAMBARUS ACHERONTIS Lönnberg

FIGURE 15

1894. *Cambarus acherontis* LÖNNBERG, Zool. Anz., vol. 17, No. 444, pp. 125–127.
1894. *Cambarus acherontis* LÖNNBERG, Bihang Svenska Vet.-Akad. Handl., vol. 20, Afd. 4, No. 1, p. 6, figs. 1–6.
1903. *Cambarus acherontis* HARRIS, Kansas Univ. Sci. Bull., vol. 2, No. 3, pp. 58, 67,[1] 150, 152, 162.

Diagnosis.—An almost colorless subterranean species with unpigmented eyes. The male with bituberculate hooks on the ischiopodites of the third and fourth pereiopods. First-form male without cephalic process on first pleopod, but with subterminal mesial process. A lyre-shaped plateau on the anteroventral portion of the annulus ventralis.

Male (form I).—Body subovate, flattened dorsoventrally. Abdomen slightly narrower than cephalothorax.

Width of carapace in region of caudodorsal margin of cervical groove greater than depth. Greatest width of carapace about midway between caudodorsal margin of cervical groove and caudal margin of cephalothorax.

Areola narrow, 20 times as long as wide. Cephalic region of carapace about 1.45 times as long as areola. Areola sparsely punctate cephalad and caudad. Sides almost parallel for a short distance in middle. (Apex of rostrum broken in male, measurements made to base of apex.)

Rostrum long, narrow, tapering cephalad. Acumen broken; lateral spines short, weakly acuminate. Small secondary tubercles on each margin of rostrum at midlength. Upper surface deeply excavate. Postorbital ridges terminating anteriorly in short spines.

Surface of carapace tuberculate laterally; dorsally polished and slightly punctate. No lateral spines.

Abdomen smooth, slightly longer and slightly narrower than cephalothorax. Anterior section of telson with one spine in each of the posterolateral corners.

Eyes reduced, not pigmented.

Epistome small, margins slightly elevated, with an anterior median spine; undulating laterally.

[1] In part; i. e. excluding "2. Gum Cave, Citrus county***"

Antennules of usual form; a spine present on ventral side of basal segment.

Antennae extending caudad slightly beyond tip of telson.

Antennal scale broad; extends cephalad to tip of rostrum; not as long as peduncle of antennae. Broadest anterior to middle. Spine on outer margin weak.

First pereiopod long and slender; palm subovate, entirely tuberculate. Fingers with weak median dorsal ridge and bent decidedly

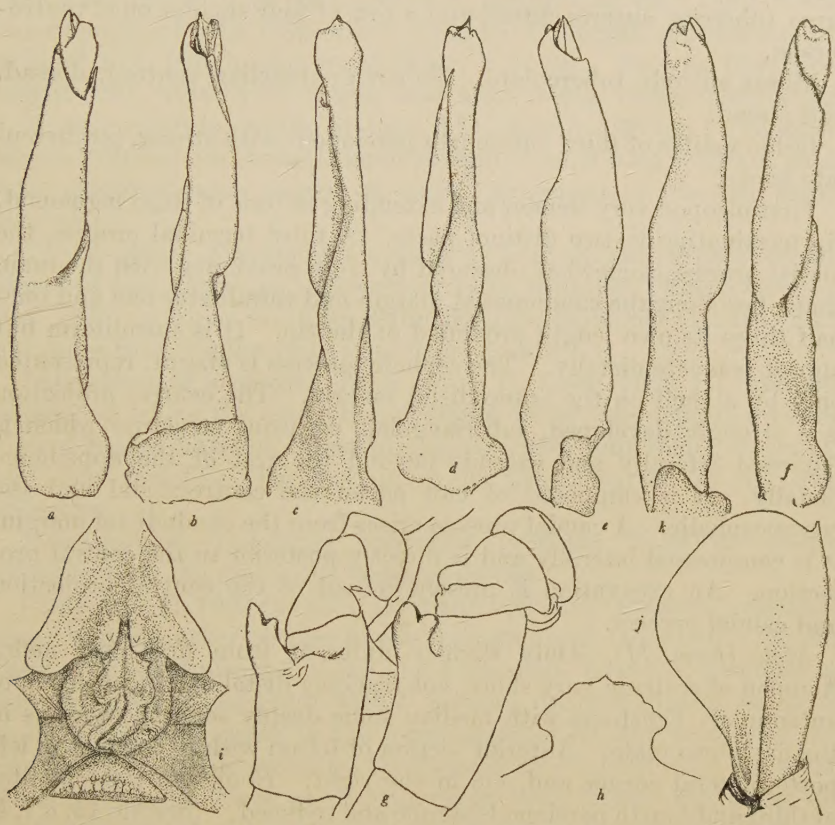

FIGURE 15.—*Cambarus acherontis* Lönnberg: *a*, Mesial view of first pleopod of male, form I; *b*, cephalic view of first pleopod of male, form I; *c*, caudal view of first pleopod of male, form II; *d*, caudal view of first pleopod of male, form I; *e*, lateral view of first pleopod of male, form I; *f*, mesial view of first pleopod of male, form II; *g*, ischiopodites of third and fourth pereiopods of male, form I; *h*, epistome of male, form I; *i*, annulus ventralis; *j*, antennal scale; *k*, lateral view of first pleopod of male, form II. Pubescence has been removed from all first pleopods.

ventrad. About 11 tubercles in silhouette irregularly arranged along inner margin of palm.

Movable finger with about 19 tubercles along mesial margin; lateral margin with one corneous tubercle in proximal third and about five

very low corneous knobs just distad of this tubercle. Entire lateral margin covered with minute denticles and scattered setae.

Immovable finger with five low, rounded knobs along proximomesial margin, just distad of which is a large corneous tubercle. Entire mesial margin with minute denticles. About 11 small tubercles on proximal lateral margin.

Carpus about 1.6 times as long as wide; a shallow oblique groove above. Punctate dorsolaterally, otherwise tuberculate. Two very large tubercles anteroventrad and a row of four smaller ones ventromesad.

Merus entirely tuberculate. Tubercles spikelike ventrad, dorsad, and mesad.

Ischiopodites of third and fourth pereiopods with strong, bituberculate hooks.

First pleopod very slender and extending to base of third pereiopod; tip terminating in two distinct parts. A third terminal process, the mesial process, somewhat obscured by close proximity with the main shaft, lies along the caudomesial margin and terminates one and one-half times its own length proximad of the tip. It is spiculiform but almost truncate distally. The cephalic process is absent, represented only by a shelf on the anterodistal margin. The central projection is a strongly developed, subtriangular, corneous structure which is flattened laterally and extends beyond the rest of the appendage distally. It is composed of two parts: the centrocaudal and the centrocephalic. A caudal process arises from the caudodistal margin; it is compressed laterally and is directly posterior to the central projection. An excavation is present mesad of the central projection and caudal process.

Male (*form II*).—Only slightly different from first-form male. Acumen of rostrum very short, not reaching distal end of peduncle of antennule. Epistome with median spine deeply set, otherwise as in the first-form male. Anterior section of telson with two spines in left posterolateral corner and one in the right. Hooks on ischiopodites of third and fourth pereiopods simple and reduced. (See fig. 15, *c*, *f*, *k*, for diagrams of first pleopod.)

In contrast to Lönnberg's description (1894b, p. 6) there are very small "lateral teeth" on the rostrum of my specimens. The ridge which Lönnberg speaks of as being present in "the foremost part of the rostral groove" is present in one of my specimens. Occasionally an extra spine is added in one or both posterolateral corners of anterior section of telson. Antennae generally slightly longer than body. One of my second-form males agrees perfectly with Lönnberg's description (i. e., proportionally) except that the areola of my specimen is narrower than his; this difference holds in all my specimens. It is possible that this difference is due to our measuring the width of the

areola in different places or to his including the light-colored areas bordering the sutures.

Female.—One or two additional spines are present along left rostral ridge, otherwise like first-form male.

Annulus ventralis movable. Cephalic portion hidden beneath two projections from the sternum just anterior to it. (See fig. 15, *i.*)

Measurements.—Male, form I: Carapace, height 0.96, width 1.21, length 2.46 cm.; areola, width 0.07, length 1.05 cm.; rostrum, width at base 0.32, length 0.54 cm.; abdomen, length 2.55 cm.; right chela, inner margin of palm 0.80, width of palm 0.47, length of outer margin of hand 2.14, length of movable finger 1.22 cm. Female: Carapace, height 0.92, width 1.27, length 2.52 cm.; areola, width 0.07, length 1.07 cm.; rostrum, width at base 0.31, length 0.56 cm.; abdomen, length 2.50 cm.; right chela, inner margin of palm 0.52, width of palm 0.32, length of outer margin of hand 1.39, length of movable finger 0.73 cm.

Type locality.—Lönnberg's types came from an underground rivulet about 42 feet below the surface near Lake Brantley, Orange County, Fla. My neotypes are from Palm Springs, Seminole County, Fla., not more than 2 miles from Lönnberg's locality.

Disposition of neotypes.—Male (form I), male (form II), and the female, on which the above description is based, are deposited in the United States National Museum, together with four males (form II) and four females. The remaining 33 specimens are in my own collection.

Relationships.—*Cambarus acherontis* probably finds its closest affinities with the group of *Cambarus advena.*

Remarks.—In 1902 (p. 277), Ortmann included *Cambarus acherontis* along with 15 other species in the first group of *Cambarus.* On the basis of the first pleopod of the first-form male, however, it should be referred to his second group with *C. advena.* In 1905 (p. 102) he seems to have been influenced in the formulation of his key to species and probably also in his grouping by Faxon's determination of his specimens from Gum Cave as *C. acherontis,* thus further confusing the taxonomic status of this misunderstood species by referring it to the group of *C. blandingi.*

Faxon's record (1914, p. 368) of *C. acherontis* from Eustis, Lake County, is based on two second-form males and seven females, all immature. I have examined these specimens and find that, although they have their closest affinities with *C. lucifugus lucifugus* from Gum Cave, they are certainly not identical with that subspecies, for I have carefully compared the immature specimens from Eustis with immature *lucifugus lucifugus* from Gum Cave. I believe they represent an undescribed subspecies of *lucifugus* because of the morphological

differences they exhibit from the known subspecies and because the various subspecies of *C. lucifugus* are extremely limited in their distribution. The Eustis specimens have the sides of the rostrum more constricted at the base, the body is slightly less granulate, and the epistome is slightly different. In the Gum Cave forms the mesial process of the first pleopod of the male is directed more laterad. As we have no mature specimens, this subspecies will have to remain without a name.

CAMBARUS PALLIDUS, new species

FIGURE 16

1938. *Cambarus acherontis pallidus* HOBBS,[2] Proc. Florida Acad. Sci., vol. 2, p. 90. *Nomen nudum.*

Diagnosis.—An albinistic subterranean species with unpigmented eyes. Rostrum wider at base than at any point along midlength. The sternum just anterior to the annulus ventralis bears large multituberculate processes, which almost fuse along the midventral line. First pleopod of first-form male bears all five processes and has a hump on anterior surface.

Male holotype (form I).—Body in cross section almost cylindrical, slightly flattened dorsoventrally. Abdomen narrower than cephalothorax.

Width of carapace in region of caudodorsal margin of cervical groove much greater than depth. Greatest width of carapace about midway between caudodorsal margin of cervical groove and caudal margin of cephalothorax.

Areola almost obliterated, about 28 or more times as long as wide, slightly depressed. Cephalic region of carapace about 1.36 times as long as areola. Areola without punctations. Sides parallel for a short distance in middle.

Rostrum long, acutely tapering. Acumen short; lateral spines small. Apex reaching a little beyond base of third segment of peduncle of antennule; upper surface deeply excavate. Postorbital ridges terminating anteriorly in short spines, extending posteriorly about two-thirds the distance between tip of rostrum and cervical groove.

Surface of carapace tuberculate. Tubercles spiniform. Plane only in areola and gastric region, here smooth and polished. Lateral spines trituberculate (only one spine on either side larger than other tubercles). Cephalolateral margins each with one spine near the anterior extremity of cervical groove.

Abdomen slightly narrower and about the same length as cephalothorax. Anterior section of telson with two spines in each of the posterolateral corners.

[2] Owing to an unfortunate misunderstanding, this manuscript name, based upon my original erroneous interpretation of Lönnberg's *Cambarus acherontis*, appeared shortly before the present paper was ready for publication.

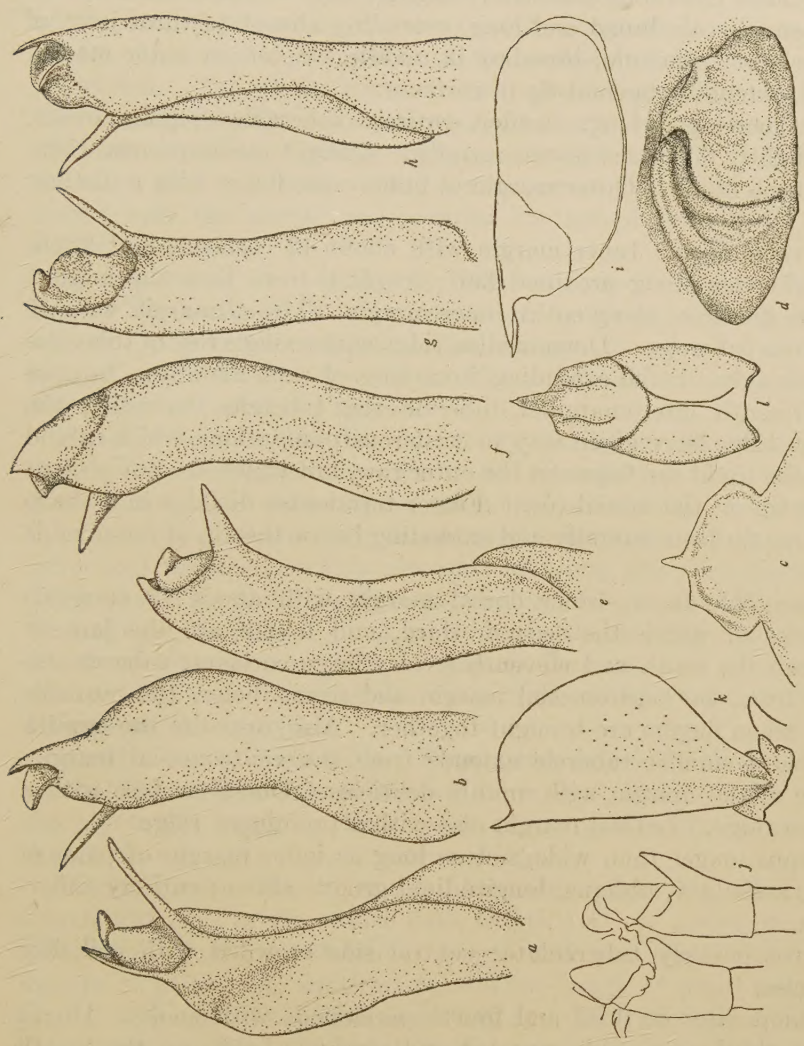

FIGURE 16.—*Cambarus pallidus*, new species: *a*, Mesial view of first pleopod (holotype); *b*, lateral view of first pleopod (holotype); *c*, epistome; *d*, annulus ventralis; *e*, mesial view of first pleopod of male, form II; *f*, lateral view of first pleopod of male, form II; *g*, anteromesial view of first pleopod (holotype); *h*, posterolateral view of first pleopod (holotype); *i*, lateral view of carapace; *j*, ischiopodites of third and fourth pereiopods of male, form I; *k*, antennal scale; *l*, dorsal view of carapace. Pubescence has been removed from all first pleopods.

Eyes reduced, not pigmented.

Epistome small, margins slightly raised, with an anterior median spine and a right lateral one—left lateral margin unbroken.

Antennules of usual form; a spine present on ventral side of basal segment.

Antennae extending posteriorly slightly beyond tip of telson.

Antennal scale broad and long, extending almost to third joint of peduncle of antennule; broadest in middle. Spine on outer margin strong, extending beyond tip of rostrum.

First pereiopod long, slender, entirely tuberculate; palm ovate, only slightly depressed dorsoventrally. A slight median dorsal ridge along each finger. Outer margin of immovable finger with a distinct ridge.

Movable finger: Inner margin with about 12 corneous and knob-like tubercles along proximal half; the fifth from base the largest. Minute denticles along entire inner margin. Mesial margin with 16 setiferous tubercles. Dorsomedian ridge with a single row of tubercles on each side. Setae extending from base of each distally. Beyond the fifteenth lateromarginal tubercle the tubercles bounding the median ridge have given way to setiferous punctations, which extend on to the tip of the finger on the outer row, but which are not present to the tip on the mesial row. Finger terminates distally in a sharp corneous tip bent laterally and extending below the tip of immovable finger.

Immovable finger: Inner dorsal margin with about 13 corneous tubercles of which the second, third, and fourth are the largest. Between the tenth and eleventh a very large corneous tubercle extends from the ventromesial margin and passes below the movable finger when fingers are brought together. Also, opposite the twelfth tubercle a smaller tubercle extends from the ventromesial margin. Entire mesial margin with minute denticles. Dorsal surface with a median ridge. Lateral margin also with a prominent ridge.

Carpus longer than wide, not so long as inner margin of palm of chela; a shallow, oblique, longitudinal groove above; entirely tuberculate.

Merus entirely tuberculate; ventral side crowded with spikelike tubercles.

Ischiopodites of third and fourth pereiopods with hooks. Hooks on the third pereiopods rounded and straight; hooks on the fourth with caudoventral surface rounded and cephalodorsal surface excavate.

First pleopod extending to base of the coxopodite of the third pereiopod; tip terminating in four distinct parts, as follows: The mesial process is long and spiculiform, directed at about a 45° angle

with the main shaft, and extending beyond the posterior margin of the appendage. The cephalic process is elongate, extending beyond the rest of the appendage distally, and somewhat hooding the central projection anteriorly. The central projection, entirely corneous, is made up of two fused processes: The centrocaudal process, contributed from the lateral base of the cephalic process forms the caudal entity of the central projection; the centrocephalic process arises from the center of the organ and makes up the cephalic entity of the central projection. The whole process is bent caudad at a right angle with the main shaft. The caudal process, also corneous, is a long, curved, bladelike structure forming the posteromesial margin of the tip of the outer part. It is somewhat convex mesially and it is continuous distad with the mesial and anterior controcephalic process of the central projection.

Male (form II).—Only slightly different from the male of the first form. The hooks on the ischiopodites of the third and fourth walking legs are very much reduced. The epistome is more regular, with only a single medial crenation. The other differences are minor variations and need not be pointed out.

Female allotype.—The female is very similar to the male of the first form, differing greatly only in the secondary sexual characters. The sternum just anterior to the annulus ventralis, between the fourth pereiopods bearing large multituberculate (three to five tubercles) processes, which almost fuse along the midventral line. (This character alone easily separates the female *C. pallidus* from *C. lucifugus lucifugus*.) Just posterior to the annulus the knoblike structure between the fifth pereiopods is small and quadrituberculate. Epistome more regular than in the male, form I, with only a single medial crenation.

Annulus ventralis movable. Sinus arises anteriorly along the midventral line and extends to the left for a short distance, then bends sharply to the right, finally curving gently posteriorly, terminating slightly to the right of the midventral line.

Measurements.—The holotype: Carapace, height 1.4, width 1.71, length 3.47 cm.; areola, width 0.05, length 1.41 cm.; rostrum, width 0.37, length 0.76 cm.; abdomen, length 3.32 cm.; right chela, inner margin of palm 1.14, width of palm 0.69, length of outer margin of hand 3.35, length of movable finger 1.92 cm. The allotype: Carapace, height 1.41, width 1.72, length 3.55 cm.; areola, width 0.08, length 1.42 cm.; rostrum, width 0.37, length 0.83 cm.; abdomen, length 3.34 cm.; right chela, inner margin of palm 1.14, width of palm 0.63, length of outer margin of hand 3.32, length of movable finger 2.05 cm.

Color.—This crayfish is almost snow white in life, turning dark only after preservation. The animals live very successfully in aquaria and

usually retain their white color. I have named this species *Cambarus pallidus* because, in contrast to its closest known relative, *Cambarus lucifugus*, of Gum Cave, Citrus County, Fla., the abdomens of the females are usually snow white, whereas those of *lucifugus* have a straw-brown tint. Males of both species are entirely white.

Type locality.—Warrens Cave, 11 miles northwest of Gainesville, Alachua County, Fla., October 8, 1937.

The male holotype and the female allotype, U.S.N.M. No. 76591, and a second-form male paratype are deposited in the United States National Museum. Of the remaining paratypes, one female has been deposited in the Museum of Comparative Zoology; one female in the University of Michigan Museum of Zoology; one male, form I, three males, form II, and six females are retained in my personal collection.

Distribution.—I collected this new crayfish on March 23, 1935, from a small area of subterranean water exposed in the bottom of a cavelike lime sink in the southern part of Columbia County. Frank N. Young secured a male, form II, and a female from Warrens Cave, 11 miles west of Gainesville, on April 22, 1937. From the same locality, on April 29, 1937, T. Carr collected the first male, form I, I had seen. Since that time, three females and one male, form I, have been added to my collection.

Relationships.—*Cambarus pallidus* has its closest affinities with the cavernicolous forms, *Cambarus lucifugus lucifugus* and *C. lucifugus alachua* (described below). It is probable that *C. pictus* (described below) and *C. pubescens* are its closest surface relatives; the former is probably more closely akin to *C. pallidus* than is the latter.

CAMBARUS LUCIFUGUS LUCIFUGUS, new species and subspecies

FIGURE 17

1898. *Cambarus acherontis* FAXON, Proc. U. S. Nat. Mus., vol. 20, p. 645, pl. 62, figs. 1–5.
1902. *Cambarus acherontis* ORTMANN, Proc. Amer. Philos. Soc., vol. 41, No. 171, p. 277.
1903. *Cambarus acherontis* HARRIS, Kansas Univ. Sci. Bull., vol. 2, No. 3, pp. 67, 150.[3]
1905. *Cambarus acherontis* ORTMANN, Proc. Amer. Philos. Soc., vol. 44, No. 180, p. 102.

Diagnosis.—A cavernicolous species with unpigmented eyes. Rostrum broadest distad of the base. The sternum anterior to the annulus ventralis is unmodified. First pleopod of first-form male bearing all five processes and similar to that of *C. lucifugus alachua*, but the trough in the caudal process is deeper, and the mesial process is more spiculiform.

[3] In part, i. e., reference "2. Gum Cave, Citrus county * * *"

Male holotype (form I).—Body subovate, compressed dorsoventrally. Abdomen slightly narrower than cephalothorax.

Width of carapace in region of caudodorsal margin of cervical groove much greater than depth. Greatest width of carapace about

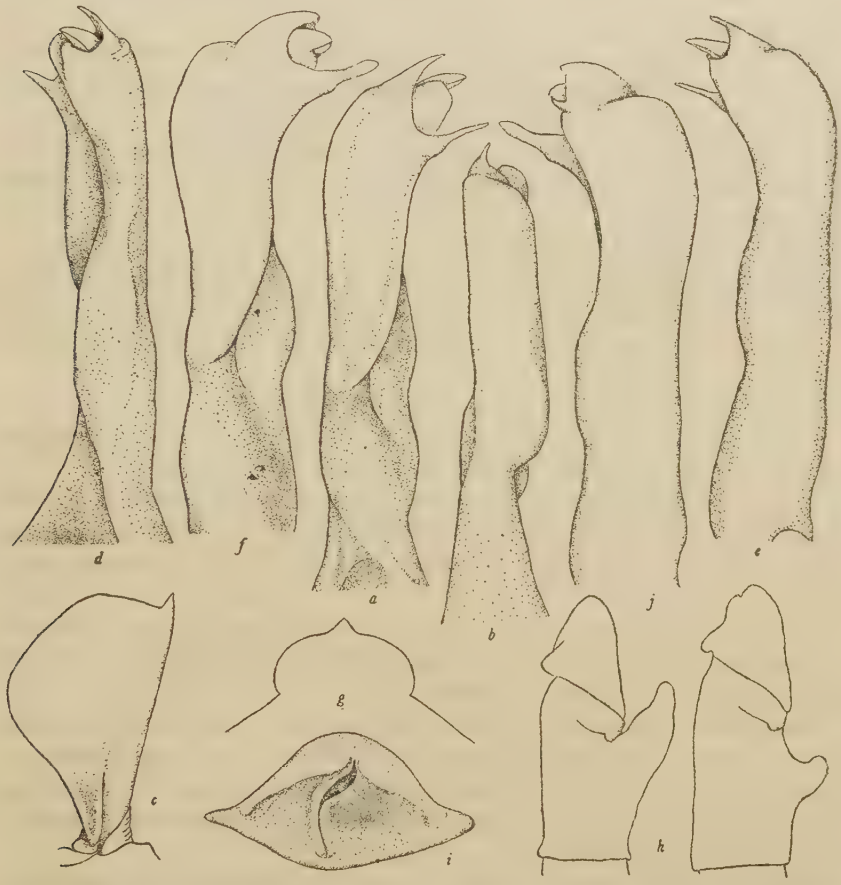

FIGURE 17.—*Cambarus lucifugus lucifugus*, new species and subspecies: *a*, Mesial view of first pleopod of male (holotype); *b*, cephalic view of first pleopod of male (holotype); *c*, antennal scale; *d*, caudal view of first pleopod of male (holotype); *e*, lateral view of first pleopod of male (holotype); *f*, mesial view of first pleopod of male, form II; *g*, epistome of male; *h*, ischiopodites of third and fourth pereiopods of male, form I; *i*, annulus ventralis; *j*, lateral view of first pleopod of male, form II. Pubescence has been removed from all first pleopods.

midway between caudodorsal margin of cervical groove and caudal margin of cephalothorax. (Right posterodorsal margin diseased.)

Areola narrow, almost obliterated. Sparsely punctate cephalad and caudad. Sides almost parallel for a short distance in middle.

Rostrum distinctly narrower at base than at midlength, converges slightly anteriorly to form a small lateral tooth on either side, which does not reach distal end of second joint of peduncle of antennule. Upper surface deeply excavate. Acumen extends slightly distad of second joint of peduncle of antennule. Postorbital ridges terminating anteriorly in short spines.

Surface of carapace punctate dorsally and tuberculate laterally; one or two tubercles immediately posterior and laterad of the cervical groove slightly larger than others.

Abdomen smooth, slightly narrower, and shorter than cephalothorax. Anterior section of telson with three spines in each of the posterolateral corners.

Eyes reduced, not pigmented.

Epistome small and minaret shaped, with a small anteromedian spine. Margins slightly raised and unbroken.

Antennules of usual form; a spine present on ventral side of basal segment.

Antennae broken but probably longer than body.

Antennal scale broad; extends cephalad to tip of rostrum; broadest slightly distad of middle. Spine on outer margin strong.

First pereiopod long and slender; palm subovate, entirely tuberculate. Fingers bent ventrad without well-defined dorsomedian ridge. About 13 tubercles in silhouette irregularly arranged along inner margin of palm.

Movable finger with about 22 tubercles along mesial margin; lateral margin with about 20 or 21 low tubercles along proximal half. Entire lateral margin with minute denticles.

Immovable finger with about 11 tubercles along proximolateral margin; about 18 tubercles along the proximal dorsomesial margin. Opposite the fifteenth and between the sixteenth and seventeenth are two larger corneous tubercles along the ventromesial margin. Entire mesial margin with minute denticles.

Carpus about 1.8 times as long as wide; a shallow groove above. Entirely tuberculate, although sparsely so dorsad and ventrad. One large spine on the anterior mesioventral margin.

Merus plain proximolaterad, otherwise tuberculate. Tubercles spikelike ventrad and dorsodistad.

Ischiopodites of third and fourth pereiopods with strong simple hooks.

First pleopod extends to base of third pereiopod; tip terminates in four distinct parts, which are bent at about a 60° angle with the main shaft. The mesial process, which arises from the mesiodistal margin, is spiculiform. The cephalic process is an elongate, acute process with a broad base, which extends across the anterodistal tip of the appendage, hooding the central projection. The central projection

is composed of two corneous, subtriangular plates, the centrocephalic and the centrocaudal, which are flattened laterally. The caudal process, which is also corneous, extends as a sharp ridge (convex mesad) mesad of the central projection and it is directed proximodistad. The mesial, cephalic, and caudal processes are directed almost parallel.

Male (form II).—Essentially like first-form male; however, the areola is slightly broader than in holotype. Two spines present in each of the posterolateral corners of anterior section of telson. Hooks on ischiopodites of third and fourth pereiopods reduced but strongly developed. Antennae longer than body. (See fig. 17, *f*, *j*, for first pleopod.)

Female allotype.—Differs only slightly from the holotype. Anterior section of telson with four spines in the right posterolateral corner and three in the left. Areola broader than in holotype. Other differences may be noted in measurements.

Faxon (1898, pl. 62, figs. 1, 5) figured the dorsal aspect of a female and the annulus ventralis. (See fig. 17, *i*, for annulus ventralis of allotype.)

Measurements.—The holotype: Carapace, height 1.42, width 1.6, length 3.52 cm.; areola, width 0.05 approximately, length 1.41 cm.; rostrum, width at base 0.41, length 0.79 cm.; abdomen, length 3.35 cm.; right chela, inner margin of palm 1.21, width of palm 0.65, length of outer margin of hand 3.38, length of movable finger 1.90 cm. The allotype: Carapace, height 1.31, width 1.56, length 3.4 cm.; areola, width 0.10 approximately, length 1.31 cm.; rostrum, width at base 0.41, length 0.82 cm.; abdomen, length 3.10 cm.; right chela, inner margin of palm 0.85, width of palm 0.57, length of outer margin of hand 2.84, length of movable finger 1.83 cm.

Type locality.—Gum Cave, about 5 miles southwest of Floral City, Citrus County, Fla. This cave is also known by the names Sweet Gum Cave and Gum Tree Cavern. The material which Faxon had referred to *C. acherontis* in 1898 (p. 645) was also collected in Gum Cave. It is on deposit in the United States National Museum and consists of 2 females and 12 young (males, form II; females). He described and figured the dorsal aspect of a female, the annulus ventralis, and the first pleopod of one of the young males, form II.

The male holotype (No. 77916), the female allotype (No. 77918), and a second-form male paratype (No. 77917) are deposited in the United States National Museum. Of the remaining paratypes one male, form I, and a female have been deposited in the Museum of Comparative Zoology; one male, form I, and a female in the University of Michigan Museum of Zoology; 8 first-form males, 18 females, 2 immature males, and 1 immature female are retained in my own collection.

Distribution.—*Cambarus lucifugus lucifugus* is known from two localities in Florida: One, the type locality, Gum Cave, Citrus County, and the other a cave about 14 miles north of Weekiwatchee Springs, Hernando County.

Relationships.—*Cambarus lucifugus lucifugus* is very closely allied to a cavernicolous form occurring in Alachua County, Fla., *C. lucifugus alachua.*

CAMBARUS LUCIFUGUS ALACHUA new subspecies

FIGURE 18

Diagnosis.—A subterranean albinistic species with a small pigment spot in the eye. Rostrum tapering. First pleopod of first-form male bears all five processes and is similar to that of *C. lucifugus lucifugus*, but the trough in the caudal process is shallower, the mesial process is not so spiculiform, and the central projection is more curved.

Male holotype (form I).—Body subcylindrical, slightly flattened dorsoventrally. Abdomen narrower than cephalothorax.

Width of carapace in region of caudodorsal margin of cervical groove much greater than depth. Greatest width of carapace midway between cervical groove and caudal margin of cephalothorax.

Areola narrow (12 to 13 times as long as wide), not depressed, polished; a single row of punctations in narrowest portion. Anterior section of carapace around 1.6 times as long as areola.

Rostrum narrow, gently tapering, deeply excavate; acumen moderately long, extending from opposite middle of second segment of peduncle of antennule to distal margin of last segment of peduncle of antennule. Lateral spines strong, the left bispinose; many specimens seem to add at random an extra spine on the margin of the rostrum. Postorbital ridges terminating anteriorly in long, sharp spines, posterior margins bearing several spiniform tubercles.

Surface of carapace bearing spiniform and rounded tubercles except dorsally, where it is smooth and polished; gastric region with a few shallow punctations bearing setae at the base. One large lateral spine on either side of carapace. Cephalolateral margins each with one strong spine near anterior extremity of cervical groove.

Abdomen narrower than cephalothorax but equal to it in length. Anterior section of telson with one spine in each of the posterolateral corners.

Eyes reduced; however, bearing a small pigmented spot.

Epistome subtrapezoidal in shape, each of the four corners with moderate spines. Anterior margin concave, with a small triangular process in the middle.

Antennules of the usual form with a strong, slender spine on ventral side of basal segment.

Antennae broken but probably longer than carapace.

FIGURE 18.—*Cambarus lucifugus alachua*, new subspecies: *a*, Mesial view of first pleopod (holotype); *b*, lateral view of first pleopod (holotype); *c*, epistome; *d*, lateral view of carapace; *e*, antennal scale; *f*, ischiopodites of third and fourth pereiopods of male, form I; *g*, posterolateral view of first pleopod (the terminal processes of the holotype); *h*, anteromesial view of first pleopod (the terminal processes of the holotype); *i*, annulus ventralis; *j*, mesial view of first pleopod of male, form II; *k*, lateral view of first pleopod of male, form II; *l*, dorsal view of carapace. *m*, Mesial view of first pleopod of *Cambarus lucifugus lucifugus*, male, form I; *n*, lateral view of first pleopod of *Cambarus lucifugus lucifugus*, male, form I. Pubescence has been removed from all first pleopods.

226833—40——3

Antennal scale large, extremely broad; broadest in middle. Spine on outer distal margin strong, extending anteriorly almost to tip of rostrum.

First right pereiopod slender, entirely tuberculate; palm oval, depressed dorsoventrally. Median dorsal ridge along each finger; outer margin of immovable finger with distinct ridge.

Movable finger: Inner margin with about 18 corneous and knob-like tubercles along proximal half, the sixth from base the largest; minute denticles along entire inner margin. Mesial margin with about 17 tubercles. Dorsomedian ridge flanked by small irregularly spaced tubercles along proximal half. Distal half flanked by a row of setiferous punctations on either side. Finger terminates distally in a sharp, corneous tip bent laterad and extending below the tip of immovable finger when the fingers are closed.

Immovable finger with inner dorsal margin bearing about 13 corneous tubercles, the third and fifth largest. Between the eleventh and twelfth tubercles a large corneous tubercle extends from the ventromesial margin, and when the fingers are brought together the movable finger passes above it. Distad of this tubercle and in the same line are two smaller tubercles. Entire mesial margin with minute denticles.

Carpus longer than broad, shorter than inner margin of palm of chela; a shallow, oblique longitudinal groove above; tuberculate except on ventral surface.

Merus tuberculate except along the proximomesial and proximolateral surfaces. Ventral side crowded with spikelike tubercles.

Ischiopodites of third and fourth pereiopods bearing hooks. Hooks corneous; both recurved toward the base of ischiopodite distally. Hook on fourth pereiopod heavier.

First pleopod extending to base of third walking leg; tip ending in four distinct parts, as follows: The mesial process, a long, extremely slender spine, projects posteroventrally and is bent at about a 50° angle with the main shaft. The cephalic process, also spiniform, rises from the anterior margin and projects in a direction almost parallel to the mesial process. The central projection consists of two processes: A centrocaudal process, which is contributed from the cephalic process laterally, forming the caudal entity; a centrocephalic process arising from the center of the appendage and making up the cephalic entity; these two are fused into a triangular platelike process (viewed laterally) bent in the same direction as the mesial process, this triangular process being the largest of the four terminal parts. The caudal process also consists of two parts: A mesial, bladelike, corneous structure directed obliquely anterolaterally and posteromesially; a small corneous, triangular structure just posterolaterad of, and at the base of, the central projection. The central projection and the caudal process are corneous.

Male (form II).—The second-form male differs from the male, form I, in the following points: The antennae extend beyond the tip of telson, epistome resembles a minaret in silhouette; the rostral spines are normal; however, the acumen bears a spine on the right margin and the right subrostral ridge bears four acute, anteriorly projecting spines, and the left, one; hooks on ischiopodite of both third and fourth pereiopods reduced but prominent; all terminal processes of the first pleopod are noncorneous and reduced. Particularly is this true of the cephalic process.

Female allotype.—The shape of the rostrum more nearly approaches that of *Cambarus lucifugus lucifugus* than does the rostrum of the holotype; also the acumen is relatively shorter; the rostral spines are normal. Antennae extending posteriorly to middle of telson. Epistome as in holotype except anteromedian spine is much more prominent. Anterior section of telson with one spine in the left and two in the right posterolateral corner.

Annulus ventralis bearing a prominent ridge along the anterior margin on either side of the median line. Sinus originates on the anterior margin on about the midventral line and extends to the left for a short distance, then turns gently to the right to the midventral line, following it for a short distance to a large tubercle, which arises from the posteromedian surface. Posterior to the annulus and between the fifth pereiopods, the sternum is modified into a rounded prominence bearing punctations. The sternum immediately anterior to the annulus is plain.

Measurements.—The holotype: Carapace, height 1.87, width 1.52, length 3.44 cm.; areola, width 0.12, length 1.30 cm.; rostrum, width 0.42, length 0.87 cm.; abdomen, length 3.54 cm.; right chela, inner margin of palm 1.14, width of palm 0.63, length of outer margin of hand 3.41, movable finger 2.15 cm.; carpus of first right pereiopod, length 0.76, width 0.50 cm. The allotype: Carapace, height 1.40, width 1.57, length 3.52 cm.; areola, width 0.14, length 1.35 cm.; rostrum, width 0.43, length 0.85 cm.; abdomen, length 3.58 cm.; right chela, inner margin of palm 0.84, width of palm 0.47, length of outer margin of hand 2.56, movable finger 1.57 cm.; carpus of first right pereiopod, length 0.79, width 0.40 cm.

Type locality.—A small cave, Hog Sink, about 10 miles west of Gainesville, Alachua County, Fla. The cave is located in high pinewoods owned by the Cummer Lumber Co., and it is very difficult to find, as no road leads to it. The cave extends downward 25 to 35 feet and then to the north about the same distance. The greater portion of it is occupied by a pool of clear, cool water, with a pH of 7.1. The pool is shallow at the south and slopes gently deeper to the north. Light reaches the southern edge of the pool, but the northernmost edge is dark. The specimens were taken on November 30, 1937.

The male (form I) holotype and the female allotype (No. 76592) and a male (form II) paratype are deposited in the United States National Museum; a male (form II) and a female in the Unitersity of Michigan Museum of Zoology; one male (form I), one male (form II), 18 females, 9 immature males, and 20 immature females are retained in my personal collection.

Relationships.—*Cambarus lucifugus alachua* is most closely related to *C. lucifugus lucifugus* of Gum Cave, Citrus County, Fla. I have found specimens which appear to be intergrades between these two subspecies in Marion County. The range of this new subspecies, as far as my collections show, is the central western part of Alachua County, while *Cambarus lucifugus lucifugus* has been collected from Citrus and Hernando Counties, Fla. Thus it seems logical that, if there be a transition group, Marion County is the place to expect it, and there is little doubt in my mind that my specimens from Indian Cave, Marion County, are intergrades, *lucifugus* × *alachua*.

CAMBARUS HUBBELLI, new species

FIGURE 19

Diagnosis.—Areola relatively broad. Rostrum without lateral spines. Male with hooks on the ischiopodites of the third pereiopod only, and the chelae with the inner margin of the palm barbate. First pleopod of first-form male bearing all five processes; the caudal process forms a fanlike structure along the caudolateral margin; a terminal tuft of setae is borne on a small distal knob.

Male holotype (form I).—Body moderately slender, somewhat thickened dorsoventrally. Abdomen only slightly narrower than cephalothorax.

Carapace subovate. In region of caudodorsal margin of cervical groove, width of carapace slightly greater than depth. Greatest width of carapace just posterior to the posterodorsal margin of the cervical groove.

Areola about 5.2–5.3 times as long as wide, not depressed. Cephalic region of carapace more than twice as long as areola; three irregular rows of punctations present in areola. Sides parallel for a short distance in middle.

Rostrum suboblanceolate, directed ventrad anteriorly, terminating, however, in a slightly upturned tip, apex just reaching distal end of second joint of peduncle of antennule, upper surface punctate, plane, with margins only slightly elevated. Cephalic region, in lateral aspect, with two rounded prominences: The anterior, consisting of the rostrum, which extends posteriorly to the anterior end of the postorbital ridges; and the posterior, which extends from the anterior edge of the postorbital ridges to the cervical groove, and is more highly arched at

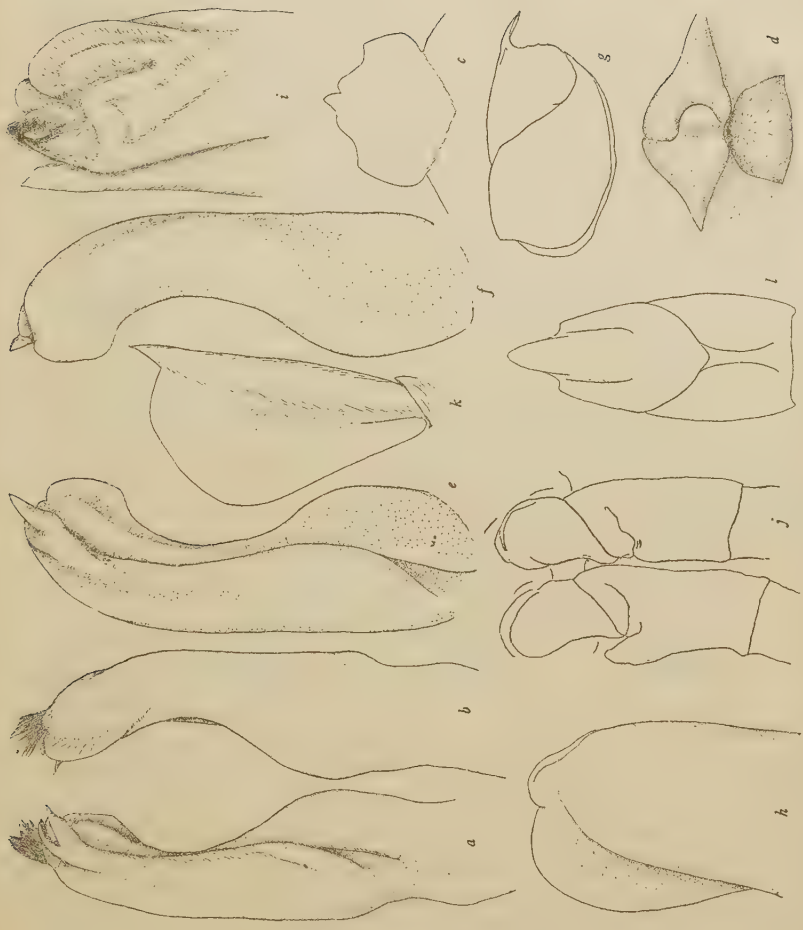

FIGURE 19.—*Cambarus hubbelli*, new species: *a*, Mesial view of first pleopod (holotype); *b*, lateral view of first pleopod; *c*, epistome; *d*, annulus ventralis (allotype); *e*, mesial view of first pleopod of male, form II; *f*, lateral view of first pleopod of male, from II; *g*, lateral view of carapace; *h*, anterior view of terminal processes of first pleopod of male (holotype); *i*, posterior view of terminal processes of first pleopod of male (holotype); *j*, ischiopodites of third and fourth pereiopods (holotype); *k*, antennal scale; *l*, dorsal view of carapace. Pubescence has been removed from all first pleopods except the terminal tuft of hairs on figs. *a*, *b*.

midlength than the anterior. Postorbital ridges extending posteriorly more than half the distance between apex and cervical groove.

Surface of carapace punctate, with minute tubercles laterally. No lateral spines present. Cephalolateral margins each with one spine near the anterior extremity of cervical groove.

Abdomen slightly longer and slightly narrower than carapace. Anterior section of telson with two spines in each of the posterolateral corners.

Ventral surface of cephalothorax and third maxillipeds heavily barbate.

Epistome broader than long, margin elevated with two strong obtuse median crenations and two weaker lateral crenations.

Antennules of the usual form. A spine present on ventral side of basal segment.

Antennae extending posteriorly about midway of the fourth abdominal segment.

Antennal scale of moderate size, broadest anterior to middle, extending to the tip of the second joint of peduncle of antennule, spine on outer margin strong.

First pereiopod heavy. Setiferous punctations scattered over entire hand; inner margin of palm barbate (sometimes only the right). A single distinct dorsomedian ridge along both fingers. Outer margin of immovable finger with a distinct ridge.

Movable finger: Inner margin with about 11 truncate or knoblike tubercles; the distal half crowded with minute denticles. Mesial margin with about 13 small tubercles irregularly arranged along proximal half. Dorsal surface with a median ridge.

Immovable finger: Inner margin with about 11 truncate or knoblike tubercles; the fourth from base and the eleventh largest; the eleventh not in line with the others but slightly more ventrad. Minute denticles crowded along the distal third. Outer margin bears a ridge with a single row of setose punctations on either side. Dorsal surface also with a median ridge.

Carpus longer than wide, not so long as inner margin of palm of chela, a shallow longitudinal groove above, inner side tuberculate, otherwise covered with setiferous punctations.

Merus with scattered tubercles above and sparsely punctate laterally and mesially; ventromesial margin with about 16 serrations; ventrolateral margins with about 16 irregularly spaced tubercles; anterooblique margin joining these with four tubercles.

Ischiopodites of the third pereiopods hooked. Hooks simple, moderately strong; caudodorsal surface excavate.

First pleopod extending to anterior margin of coxopodite of fourth pereiopod. Tip terminating in four distinct parts, as follows: The

mesial process, a subcylindrical, subulate, corneous one, extends caudoventrally at about a 50° angle with the main shaft and does not extend beyond the rest of the terminal processes distally. The cephalic process consists of a very low, noncorneous, knoblike structure bearing a terminal tuft of setae; extending from its mesial margin is a larger, corneous, triangular process which somewhat shields the central projection anteriorly. The central projection, entirely corneous, consists of two partially fused processes: A small centrocaudal process (contributed from the lateral base of the knoblike structure) smaller than the centrocephalic process and extending only about halfway to the tip of the latter; the centrocephalic process, somewhat compressed laterally, arises from the center of the appendage, is directed caudoventrally, and is distally deflected at about a right angle with the main shaft. The caudal process is a large, corneous, fanlike structure situated along the distal posterolateral surface.

Male (form II).—The second-form male differs from the first-form male in a few minor details. Chiefly, the spiny parts are all reduced and the first pleopod bears no corneous tips.

Female allotype.—Besides the sexual characters, the female shows the following distinctive structures differing from those described in the male: Chelae proportionally smaller; anterior section of telson with three spines in the left and two in the right posterolateral corner; antennae broken but would scarcely have reached the posterior margin of carapace; 8 to 10 spines irregularly spaced along inner side of hand.

Annulus ventralis movable; sinus extending from middle of anterior margin posteriorly about one-third of the length of the annulus, bends sharply to the left and slightly anteriorly, then curves gently to the right and posteriorly to the posterior margin, cutting it slightly to the left of the midventral line. A distinct fossa is not present. Just posterior to the annulus a truncate spine is present on the sternum between the fifth pereiopods.

Measurements.—The holotype: Carapace, height 1.33, width 1.29, length 2.51 cm.; areola, width 0.14, length 0.76 cm.; rostrum, width 0.45, length 0.60 cm.; abdomen, length 2.70 cm.; right chela, inner margin of palm 0.90, width of palm 0.90, length of outer margin of hand 2.29, length of movable finger 1.23 cm. The allotype: Carapace, height 1.28, width 1.18, length 2.54 cm.; areola, width 0.19, length 0.76 cm.; rostrum, width 0.42, length 0.60 cm.; abdomen, length 2.70 cm.; right chela, inner margin of palm 0.55, width of palm 0.52, length of outer margin of hand 1.40, length of movable finger 0.80 cm.

Type locality.—A roadside ditch in the flatwoods 1 mile east of Bonifay, Holmes County, Fla., on State Highway No. 1. About 50 yards east of where I collected the type specimens is a cypress pond and swamp. Grasses, *Drosera capillaris* Poiret, *Rhexia* sp., and

pines are common. Many pine stumps are left, and their dead roots make it difficult to dig out the crayfish. The soil is a sandy-clay mixture, and the burrows range from 1 to 2 feet deep. Most of the burrows occur in the banks of the ditch and extend about 1 foot below the water table. The burrows are not simple but are less complex than those of *C. rogersi* or many of the members of the subgenus *Cambarus*. Very seldom do they branch more than twice. Usually the burrows may be easily located by the small chimneys built over the mouths. The specimens were collected on October 25, 1937.

The male holotype and the female allotype (No. 76593) and a male (form II) paratype are deposited in the United States National Museum. Of the paratypes, a male (form I), a male (form II), and a female have been deposited in the Museum of Comparative Zoology; a male (form I), a male (form II), and a female in the University of Michigan Museum of Zoology; a male (form I), a male (form II), and a female in the Charleston Museum; and I have retained 6 males (form I), 12 males (form II), 24 females, 41 immature females, and 29 immature males.

Relationships.—*Cambarus hubbelli* is probably more closely related to *Cambarus barbatus* than to any described species of *Cambarus*. Like *Cambarus barbatus*, its areola is relatively broad, its rostrum is without lateral spines, and the inner margin of the chela is usually barbate; even the body build is similar. *Cambarus hubbelli* bears hooks on the ischiopodites of only the third pereiopods, whereas *Cambarus barbatus* has hooks on both the third and fourth, and the sexual characters of each are quite distinct.

It is a pleasure to name this crayfish after Prof. T. H. Hubbell, of the University of Florida, who has so kindly aided me in my work on the distribution of these animals, and whose advice and many valuable suggestions have been of great help in my study of Florida crayfishes.

CAMBARUS KILBYI, new species

FIGURE 20

Diagnosis.—Rostrum without spines. Areola relatively broad. Male with hooks on the ischiopodites of the third and fourth walking legs, and the chelae without beard on the inner margin of the palm. First pleopod of first-form male bearing all five processes; the mesial process, the largest, is heavy and spadelike.

Male holotype (form I).—Body somewhat compressed laterally. Abdomen almost as broad as cephalothorax.

Carapace in region of caudodorsal margin of cervical groove with width slightly less than depth. Greatest width of carapace just posterior to middorsal point of cervical groove.

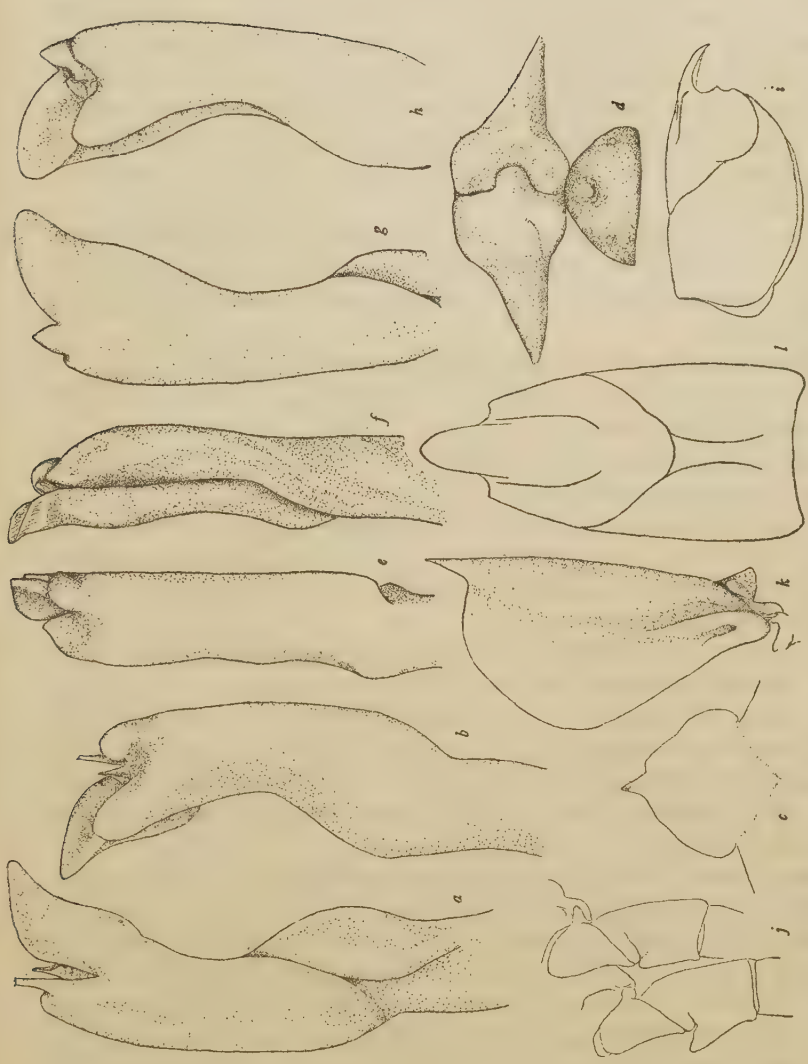

FIGURE 20.—*Cambarus kilbyi* new species: *a*, Mesial view of first pleopod (holotype); *b*, lateral view of first pleopod; *c*, epistome; *d*, annulus ventralis (allotype); *e*, anterior view of first pleopod (holotype); *f*, posterior view of first pleopod (holotype); *g*, mesial view of first pleopod of male, form II; *h*, lateral view of first pleopod of male, form II; *i*, lateral view of carapace; *j*, ischiopodites of third and fourth pereiopods of male, form I; *k*, antennal scale; *l*, dorsal view of carapace. Pubescence has been removed from all first pleopods.

Areola moderately broad and short, about six times as long as broad, not depressed. Cephalic region of carapace about 3.2 times as long as areola. Areola with two irregular rows and a few scattered punctations.

Rostrum without lateral spines, subovate. Margins almost parallel for a short distance at base, only slightly tapering up to apex when they suddenly converge to form a short tip. Apex short and small, reaching base of third segment of peduncle of antennule; upper surface plane, punctate, margins only slightly raised. Postorbital ridges terminating anteriorly without spines and extending posteriorly more than halfway between tip of rostrum and caudodorsal margin of cervical groove.

Surface of carapace punctate, and granulate ventrolaterally, especially anterior to cervical groove. Lateral spines absent. Cephalolateral margins each with a strong spine near anterior extremity of cervical groove.

Abdomen almost as broad as carapace and longer than cephalothorax. Anterior section of telson with two strong spines in each of the posterolateral corners.

Epistome (in ventral view) with margins elevated and each side with two shallow emarginations.

Antennules of the usual form. A spine present on the ventral side of basal segment.

Antennae extending posteriorly about midway of the second abdominal segment.

Antennal scale of moderate size, broadest in middle. Spine on tip of outer margin strong, extending to tip of rostrum.

First pereiopod heavy, with setiferous tubercles dorsally and ventromesially. Ventrolateral surface with setiferous punctations. A dorsomedian ridge on each finger, and a distinct ridge on lateral margin of immovable finger. About nine tubercles present along inner margin of palm.

Movable finger: Inner margin with nine corneous, knoblike tubercles. Beginning proximally, tubercles 2, 4, 6, and 8 are largest. Between 5 and 6 and between 7 and 8 a small tubercle is present dorsal to the row just mentioned; between tubercles 8 and 9 are three smaller tubercles. Minute denticles scattered along inner margin distad of the fifth tubercle. Finger entirely setose-punctate. Dorsomedian ridge prominent. Mesial margin with two small tubercles along proximal fifth.

Immovable finger: Mesial margin with 10 knoblike tubercles. The proximal 6 more corneous, and range in size in the following order: The third the largest; second, fourth, and fifth about the same size; first, sixth, seventh, eighth, tenth, ninth, progressively smaller. Besides these a larger tubercle extends from the ventromesial margin

opposite the ninth tubercle, above which the movable finger passes when the fingers are brought together. Minute denticles are scattered along entire mesial margin. Lateral margin with a longitudinal ridge. Entire finger setose-punctate.

Carpus longer than broad, not quite so long as inner margin of palm of chela. A shallow, oblique, longitudinal groove above. Setose-punctate dorsally, laterally, and ventrally. Setose-tuberculate mesially.

Merus with two spines on dorsodistal surface. About 12 to 14 tubercles on ventrolateral margin; about 13 tubercles on ventromesial margin, and about 5 on anteroventral margin. Lateral and mesial surface sparsely punctate. Ventral surface setose-punctate.

Ischiopodites of third and fourth pereiopods hooked. Hook on third moderately strong; hook on fourth small and blunt. Caudoventral margin of hook on the third rounded, cephalodorsal margin excavate and setose.

First pleopod reaching coxopodite of third pereiopod and terminating distally in four distinct parts, as follows: The mesial process, the largest of the four, is a large corneous structure extending ventrally, bent posteriorly at about a 50° angle with the main shaft and extending beyond the rest of the organ distally. The cephalic process consists of a noncorneous, knoblike structure bearing a crest of hairs, and extending ventrally from the mesial margin of the knob is a small, slender, corneous, truncate spine. The central projection, a small corneous triangular process, compressed anteroposteriorly, consists of two fused processes: a centrocaudal process (contributed from the anterior process) forming the lateral part of the projection, and a centrocephalic process rising from the center of the tip and forming the mesial part of the central projection. The caudal process is somewhat rounded and compressed laterally and extends in a ventrocaudal direction bent at about a 45° angle with the main shaft.

Male (*form II*).—Closely resembles the male of the first form but much less robust; less tuberculate, and all processes and spines greatly reduced. Hooks on ischiopodite of third pereiopod reduced almost to vestiges and absent on the fourth. Though all processes of the first pleopod are present, none are corneous or so sharply defined as in the male, form I.

Female allotype.—The female differs only slightly from the male. The chelae are not quite so heavy. Epistome has been injured but normal parts as in the first-form male. Annulus ventralis movable and small. Sinus originates on anterior border near midventral line, extends caudosinistrad, near midlength bends caudodextrad, then turns gently caudad to reach posterior margin at about midventral line. Posterior to the annulus, and between the fifth pereiopods, the

sternum is modified into a small domelike structure that terminates ventrally in a truncate spine, the latter flanked by two or three small tubercles.

Measurements.—The holotype: Carapace, height 1.30, width 1.24, length 2.55 cm.; areola, width 0.13, length 0.79 cm.; rostrum, length 0.62, width 0.40 cm.; abdomen, length 2.99 cm.; right chela, inner margin of palm 0.80, width of palm 0.84, length of outer margin of hand 1.99, length of movable finger 1.08 cm. The allotype: Carapace, height 1.18, width 1.15, length 2.31 cm.; areola, width 0.11, length 0.68 cm.; rostrum length 0.54, width 0.39 cm.; abdomen, length 2.77 cm.; right chela, inner margin of palm 0.56, width of palm 0.62, length of outer margin of hand 1.46, length of movable finger 0.83 cm.

Type locality.—A small creek about 7 miles northwest of Blountstown, Calhoun County, Fla., on State Highway No. 6. The water had a slight brownish tint and flowed through dense growth of submerged and emergent vegetation. The specimens were collected on April 17, 1937.

The male holotype (form I) and the female allotype (No. 76594) and a male paratype (form II) are deposited in the United States National Museum. Of the paratypes, a male (form I), a male (form II), and a female are deposited in the Museum of Comparative Zoology; a male (form I), a male (form II), and a female in the University of Michigan Museum of Zoology; 5 males (form I), 10 males (form II), 5 females, 37 immature males, and 43 immature females are retained in my own collection.

Relationships.—*Cambarus kilbyi* has its closest affinities with *C. barbatus* and *C. hubbelli*. The absence of marginal spines on the rostrum, the relatively broad areola, and general body-build, which are common to all three forms, point to a rather close relationship between them. As in *C. barbatus*, hooks are present on the ischiopodites of both the third and fourth pereiopods. The color pattern is almost identical with that of *C. hubbelli* (i. e., a gray-greenish background with a light cream mediodorsal stripe and a lateral stripe of the same color on either side running the entire length of the body). The absence of a barbate condition along the inner margin of the palm of the chelae (in the male), however, distinguishes *C. kilbyi*.

I take pleasure in naming this species for John D. Kilby, Resettlement Administration, Montgomery, Ala., in appreciation of assistance and companionship on numerous collecting trips.

CAMBARUS RATHBUNAE, new species

FIGURE 21

Diagnosis.—Rostrum without spines. Areola moderately broad. Male with hooks on the ischiopodites of the third walking legs only, and the chelae without beard along the inner margin of the palm.

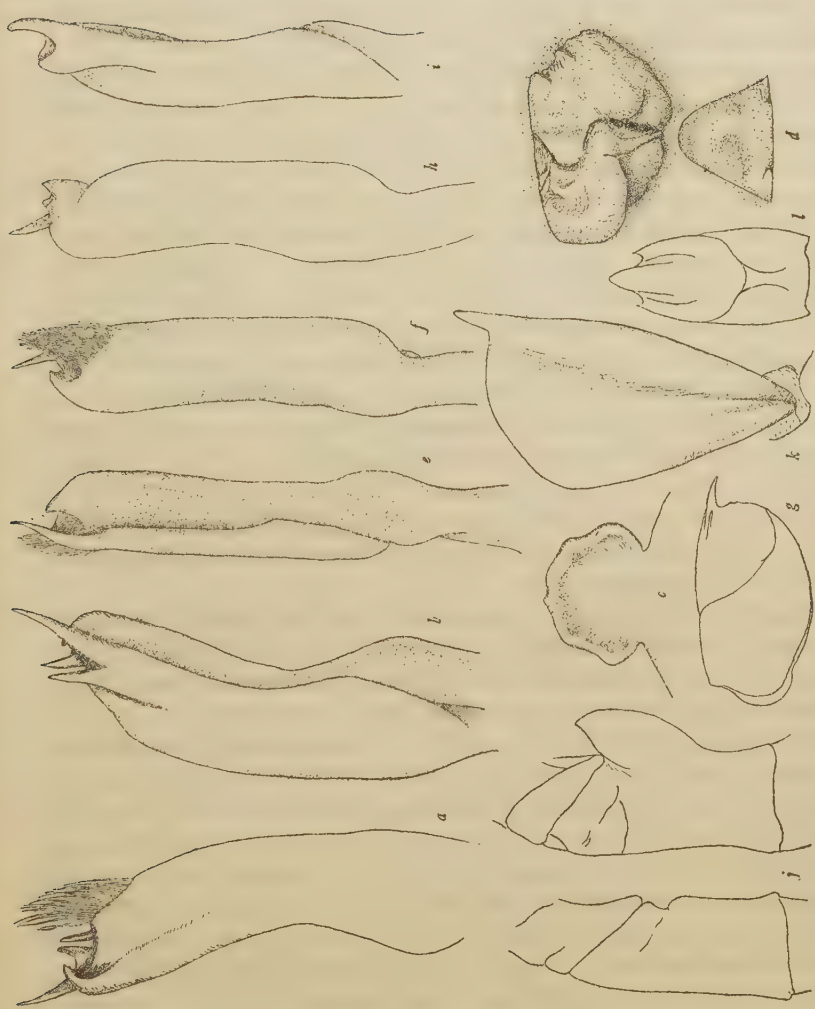

FIGURE 21.—*Cambarus rathbunae*, new species: *a*, Lateral view of first pleopod (holotype); *b*, mesial view of first pleopod (holotype); *c*, epistome; *d*, annulus ventralis (allotype); *e*, posterior view of first pleopod (holotype); *f*, anterior view of first pleopod (holotype); *g*, lateral view of carapace; *h*, lateral view of first pleopod of male, form II; *i*, mesial view of first pleopod of male, form II; *j*, ischiopodites of third and fourth pereiopods of male, form I; *k*, antennal scale; *l*, dorsal view of carapace. Pubescence has been removed from all first pleopods except the terminal tuft of hairs on figs. *a*, *e*, *f*.

First pleopod of first form male bearing all five processes; mesial process slender and extending distad of the other processes; caudal process is recurved distad and terminates in a point.

Male holotype (form I).—Body somewhat compressed laterally; abdomen only slightly narrower than cephalothorax.

Width of carapace in region of caudodorsal margin of cervical groove almost equal to depth; greatest width immediately posterior to caudodorsal margin of cervical groove.

Areola moderately broad and short, with three irregular rows of punctations, about 4.2 times as long as broad, not depressed. Cephalic region of carapace about 2.1 times as long as areola.

Rostrum without lateral spines; margins slightly raised, its apex reaching the base of the third segment of peduncle of antennule; upper surface concave, punctate. Postorbital ridges terminate anteriorly without spines and extend posteriorly more than halfway between tip of rostrum and caudodorsal margin of cervical groove.

Surface of carapace punctate above, granulate laterally. No lateral spines present. Cephalolateral margins each with one spine near anterior extremity of cervical groove.

Abdomen almost as broad as carapace, longer than cephalothorax. Anterior section of telson with two strong spines in left and one in right posterolateral corners.

Epistome with margins slightly elevated; shallowly scalloped (terminating medioanteriorly in a small blunt spine in some specimens, not, however, in the holotype).

Antennules of usual form; a spine on ventral side of basal segment.

Antennae extending posteriorly to base of fourth abdominal segment.

Antennal scale of moderate size, broadest just anterior to middle. Spine on outer margin strong, extending to tip of rostrum.

Right first pereiopod heavy. Palm setose-tuberculate; tubercles along mesiodorsal region large and bent distally. Distinct dorsomedian ridge on both finger. Lateral ridge on each finger less well developed. Twelve to 13 tubercles along inner margin of palm.

Movable finger: Inner margin with 9 or 10 rounded tubercles, the 4 proximal ones largest and of these the fourth, is the largest; minute denticles along the distal third. Ventromesial and ventrolateral margins setose-punctate. Mesial margin with 10 or 11 tubercles. Dorsomesial, proximal one-third and dorsolateral, proximal one-third with tubercles; distal two-thirds setose-punctate.

Immovable finger with five or six rounded tubercles on mesial margin, the third the largest. Ventromesial surface with one large strikingly corneous tubercle at base of distal third. Distal third with minute denticles. Finger setose-punctate otherwise.

Carpus longer than broad; about equal in length to inner margin of palm of chela, and a shallow longitudinal groove above. Setose-

punctate dorsolaterally, laterally, and ventrally. Tuberculate dorsomesially and mesially.

Merus with an irregular row of tubercles (about 30) along dorsal margin. Ventrolateral margin with about 18 tubercles. Ventromesial row branching from the ventrolateral row with about 6 tubercles. Ventromesial margin with about 21 tubercles; otherwise mostly plane, sparsely setose-punctate.

Ischiopodites of third pereiopods hooked. Caudoventral surface of hook rounded, cephalodorsal surface excavate. Fourth pereiopod with a shallow groove on the ischiopodite, its raised margin suggesting a rudimentary hook; the rounded tubercle distad of the groove very poorly developed.

First pleopod reaches the coxopodite of third pereiopods, the tip ending in four distinct parts, as follows: The mesial process, a long corneous spine, extending beyond the rest of the appendage distally and bending slightly laterally; the cephalic process arising from the anteromesial part of the organ and forming a slender corneous spine; the central projection, an anteroposteriorly flattened, triangular process, extending distad beyond the cephalic process, and consisting of two processes, a mesial or centrocephalic process arising from the center of the appendage, and a lateral or centrocephalic process contributed from the lateral surface of the cephalic process; and the caudal process arising from the posterolateral surface and distally bending anteriorly almost at a right angle with the main shaft.

Male (*form II*).—Differs from the male of the first form in only a few minor points, chiefly in the smaller degree of accentuation of the tuberculate and spiny portions. The complex arrangement of the first pleopod is much simplified and the caudal process is not even present as a vestige. The anterior section of the telson bears two spines in each posterolateral corner. A small median spine is present on the middle anterior margin of epistome.

Female allotype.—A reduced heaviness of the chelae is one of the most striking dissimilarities between the two sexes. Annulus ventralis small, movable, with large irregular tubercles on anterolateral surfaces. The sinus, beginning slightly to the left of the midanterior margin, curves gently to the right of the midventral line, then somewhat more sharply to the left, again crossing the midventral line, where it then curves gently once more to the midposterior margin. Just posterior to the annulus the sternum is modified into a small, trapezoidal, rounded plate, whose surface is broken by about six tubercles; the two occupying the posterolateral corners are larger, more nearly spiniform, and are directed mesially. Surface of sternum, immediately anterior to annulus unbroken, though the median trough is somewhat narrow with overhanging walls.

Measurements.—The holotype: Carapace, height 1.26, width 1.27, length 2.65 cm.; areola, width 0.20, length 0.84 cm.; rostrum, width 0.35, length 0.51 cm.; abdomen, length 3.00 cm.; right chela, inner margin of palm 0.82, width of palm 0.85, outer margin of hand broken, length of movable finger 1.14 cm.; carpus of first pereiopod (right), length 0.82, width 0.61 cm. The allotype: Carapace, height 1.47, width 1.39, length 2.92 cm.; areola, width 0.20, length 0.97 cm.; rostrum, width 0.35, length 0.51 cm.; abdomen, length 3.29 cm.; right chela, inner margin of palm 0.66, width of palm 0.73, length of outer margin of hand 1.78, length of movable finger 1.07 cm.; carpus of first pereiopod (right), length 0.76, width 0.50 cm.

Type locality.—Near the Yellow River at Milligan, Okaloosa County, Fla., at intersection of State Highway No. 41 and U. S. Highway No. 90. The crayfish were dug from simple burrows in the roadside ditches. The burrows ranged in depth from 1 to 2 feet, reaching the water-table 6 inches to a foot below the surface of the ground. Several of the burrows were open, though the majority of them were marked by low, closed chimneys. The soil is a sandy-clay mixture, and the ground is covered with a thick mat of grass. Some sections of the ditch held water, but at this time most of it was dry. The specimens were collected on April 4, 1938.

The male holotype (form I) and the female allotype (No. 76595) and a male paratype (form II) are deposited in the United States National Museum. Of the paratypes, a male (form II) and a female have been deposited in the Museum of Comparative Zoology; a male (form II) and a female in the University of Michigan Museum of Zoology; a male (form I), two males (form II), and six females have been retained in my own collection.

Relationships.—A rostrum without lateral spines, a broad areola, and a rather short, thick body are characteristic of four Florida crayfishes: *Cambarus barbatus*, *C. hubbelli*, *C. kilbyi*, and *C. rathbunae*. Peculiar to *C. rathbunae* and *C. hubbelli* is the presence of hooks on the ischiopodites of only the third pereiopod; however, in *C. rathbunae* the ischiopodites of the fourth pereiopods bear a tubercle which suggests a rudimentary hook. Peculiar to *C. rathbunae* and *C. kilbyi* is the lack of the barbate condition on the palm of the chelae in the male. It is to be noted that the first pleopod of *C. rathbunae* is much more like that of *C. barbatus* than that of *C. hubbelli* or *C. kilbyi*.

It is a pleasure to name this species for Dr. Mary J. Rathbun, Associate in Zoology in the United States National Museum.

CAMBARUS PICTUS, new species

FIGURE 22

Diagnosis.—Margins of rostrum with angular interruptions. Areola broad. Male with hooks on the ischiopodites of the third and fourth walking legs. First pleopod of first-form male bearing all five processes; caudal process consisting of three distinct parts—a caudolateral knob, a more mesial curved platelike structure partially enclosing the third part, which is a small toothlike structure.

Male holotype (form I).—Carapace subovate, compressed laterally. Abdomen only slightly narrower than cephalothorax. In region of caudodorsal margin of cervical groove, width slightly greater than depth. Greatest width of carapace just posterior to caudodorsal margin of cervical groove.

Areola broad, length but slightly more than twice width, not depressed. Cephalic portion of carapace more than two and one-half times as long as areola. Punctations somewhat irregularly arranged, about nine in narrowest portion.

Rostrum long, broad, sides parallel at base, converging gently to the lateral spines, which are opposite proximal part of second segment of peduncle of antennule and which mark the base of the long, narrow acumen. The distal end of the acumen opposite midlength of peduncle of antennule. Postorbital ridges terminating anteriorly in acute spines.

Surface of carapace setose-punctate dorsally, and setose and finely granulate laterally with a single strong lateral spine on each side. Cephalolateral margins each with one well-developed spine immediately ventrad of anterior extremity of cervical groove, and a weak tubercle on margin, slightly dorsad of base of antennae.

Abdomen longer than cephalothorax and only slightly narrower. Anterior section of telson with three and four spines in the right and left posterolateral corners respectively.

Epistome subtriangular in shape, heavily barbate, with margins only slightly raised.

Antennules of usual form; a strong spine present on ventral surface of basal segment.

Antennae extending to base of third segment of abdomen.

Antennal scale long, extending anteriorly beyond peduncle of antennule and tip of rostrum, broadest proximal to middle. Lateral margins concave, terminating distally in strong, acute spines.

First right pereiopod slender and long, about four times as long as broad. Fingers not gaping. Inner margin of palm almost 1.4 times as long as broad, with a row of about 10 small, regularly spaced tubercles. Entire palm setose-tuberculate, tubercles more crowded on dorsal surface. No distinct ridges on either finger. Mesial margin of

movable finger with a row of about 8 small tubercles along proximal three-fifths. Lateral margin with only one small tubercle near base, but crowded with minute denticles along entire length. Dorsoproximal and ventroproximal surfaces with a few small tubercles, otherwise setose-punctate.

Carpus longer than wide: Ratio about 9:5, shorter than inner margin of chela, a very shallow longitudinal groove above, and entirely tuberculate. Tubercles on mesial and mesiodorsal surface larger and more acute. Two sharp spines on anteroventral margin.

Merus with a row of about 20 tubercles along dorsal margin, progressively larger and more acute from proximal to distal margins. Distad of middle they are flanked by smaller ones. Lateral and mesial surfaces sparsely punctate; about 14 spines along ventromesial margin, and 10 to 15 in an irregular row along ventrolateral margin. A row of 3 tubercles (the more distad the largest) along the distal midventral margin.

Ischiopodites of the third and fourth pereiopods hooked. Hooks on the third simple, straight, extending back over the distal part of basiopodite. Hook on the fourth pereiopod approaches a trituberculate condition. Basiopodite of the fourth pereiopod bears a large tubercle on the distomesial margin opposing the hook.

First pleopod extending to middle of coxopodite of third pereiopod, a rounded hump on midposterior surface, and another at distal one-third of anteromesial surface. Tip terminating in four distinct parts, as follows: The mesial process, which is long, slender, and spiniform, extends caudoventrally. The cephalic process, also spiniform, extends in the same direction and extends distad of the other processes. The central projection consists of two parts: The centrocaudal part contributed from the cephalic process, and the centrocephalic process arising from the center of the appendage, the two fused into a small, acute, platelike structure and bent slightly more mesad and caudad than the mesial and cephalic processes. The caudal process is made up of three parts: A larger, lateral, knoblike structure; a mesial platelike structure, convex mesially; a small, acute, platelike spine, which rises from between the last two mentioned structures and extends approximately parallel to the mesial and cephalic processes and to the central projection, which exceed it distally. The central projection and caudal processes are corneous.

Male (form II).—With reductions in most of the spiny and corneous portions disregarded, the description of the male, form I, is adequate for the second-form male with the following exceptions: Anterior section of telson with four spines in each of the posterolateral corners; epistome with base angular, both sides slightly concave, spine on anterior edge not acute; first pleopod with no corneous tips and a much-reduced caudal process, a small tubercle indicating the presence

FIGURE 22.—*Cambarus pictus*, new species: *a*, Mesial view of first pleopod (holotype); *b*, lateral view of first pleopod; *c*, epistome; *d*, annulus ventralis (allotype); *e*, anterior view of first pleopod (holotype); *f*, posterior view of first pleopod (holotype); *g*, mesial view of first pleopod of male, form II; *h*, lateral view of first pleopod of male, form II; *i*, lateral view of carapace; *j*, ischiopodites of third and fourth pereiopods of male, form I; *k*, antennal scale; *l*, dorsal view of carapace. Pubescence has been removed from all first pleopods.

of the small acute platelike spine, the other two parts of this caudal process being represented by a rounded ridge across the posterodistal surface of the appendage.

Female allotype.—Essentially like the male, form I, but rostrum extending beyond peduncle of antennule and right antennal scale; also extending anteriorly about the same distance as left antennal scale. Anterior section of telson with three spines in each posterolateral corner. Epistome as in the male, form II. Merus of first pereiopods with two very large acute spines on ventrolateral margins surrounded by several smaller ones. Also one large acute spine on the anterior mesioventral surface.

Annulus ventralis subelliptical. Two prominent ridges directed obliquely, posterolaterally on anteroventral surface. Sinus arises slightly back of anterior edge along the midventral line, curves immediately to the left, then gently back to the midventral line, where it extends posteriorly, bisecting a rather large tubercle which extends caudad from the main body of the annulus. The sternum immediately posterior to the annulus is modified into a semielliptical structure with a raised anterior margin bearing many small tubercles.

Between the third and fourth pereiopods along the midventral line is a small subovate structure (resembling vaguely the annulus) bearing several ridges and depressions. In the same relative position between the second and third pereiopods is a large, bituberculate structure projecting ventrally.

Measurements.—The holotype: Carapace, height 1.69, width 1.65, length 3.73 cm.; areola, width 0.42, length 1.12 cm.; rostrum, width 0.58, length 1.25 cm.; abdomen, length 4.25 cm.; right chela, inner margin of palm 1.30, width of palm 0.71, length of outer margin of hand 2.71, length of movable finger 1.41 cm.; carpus of right first pereiopod, length 0.96, width 0.54 cm. The allotype: Carapace, height 1.29, width 1.29, length 2.92 cm.; areola, width 0.32, length 0.75 cm.; rostrum, width 0.50, length 1.06 cm.; abdomen, length 3.33 cm.; right chela, inner margin of palm 0.60, width of palm 0.45, length of outer margin of hand 1.44, length of movable finger 0.81 cm.; carpus of right first pereiopod, length 0.60, width 0.37 cm.

Type locality.—A small, swift swamp stream about 2 miles southwest of Green Cove Springs, Clay County, Fla., on Highway No. 48.

The specimens were collected on April 23, 1938.

The male holotype (form I) and the female allotype (No. 76596) and a male paratype (form II) are deposited in the United States National Museum. Of the paratypes, a male (form I), a male (form II), and a female have been deposited in the Museum of Comparative Zoology; a male (form I) and a female in the University of Michigan Museum of Zoology; five males (form I), one male (form

II), five females, and one immature male have been retained in my own collection.

Relationships.—*Cambarus pictus* probably has its closest affinities with *C. pubescens*. The following characters are common to both of these species: A broad, short areola; a long, slender antennal scale; a single well-developed lateral spine on the carapace; a long acumen on the rostrum; a telson with three or four spines in the postero-lateral corners of the anterior sections; and similar hooks on the ischiopodites of both the third and fourth pereiopods. Accompanying these similarities is the striking resemblance in the first pleopods of the males.

Despite these close similarities, the males of the two species may be separated by differences in the terminal processes of the first pleopods. In the females of *Cambarus pubescens* the portion of the sternum immediately anterior to the annulus is modified into paired prominences, arising on each side of the midventral line and extending posteriorly and ventrally toward the annulus, whereas the sternum of *C. pictus* in this region is practically plane. Differences in the chelae of both sexes are also noticeable.

LITERATURE CITED

FAXON, WALTER.

1898. Observations on the Astacidae in the United States National Museum and in the Museum of Comparative Zoölogy, with descriptions of new species. Proc. U. S. Nat. Mus., vol. 20, pp. 643–694, pls. 62–70.

1914. Notes on the crayfishes in the United States National Museum and the Museum of Comparative Zoölogy with descriptions of new species and subspecies to which is appended a catalogue of the known species and subspecies. Mem. Mus. Comp. Zoöl., vol. 40, No. 8, pp. 351–427, pls. 1–13.

HARRIS, J. ARTHUR.

1903. An ecological catalogue of the crayfishes belonging to the genus *Cambarus*. Kansas Univ. Sci. Bull., vol. 2, No. 3 (whole series vol. 12, No. 3), pp. 51–187, pls. 1–5.

HOBBS, HORTON H., JR.

1938. Two new crawfishes from Florida. Proc. Florida Acad. Sci., vol. 2, pp. 90–91.

LÖNNBERG, EINAR.

1894a. Cambarids from Florida, a new blind species. Zool. Anz., vol. 17, No. 444, pp. 125–127.

1894b. Cambarids from Florida. A new blind species, *Cambarus acherontis* mihi. Bihang Svenska Vet.-Akad. Handl., vol. 20, Afd. 4, No. 1, pp. 3–14, 1 pl.

ORTMANN, ARNOLD EDWARD.

1902. The geographical distribution of freshwater decapods and its bearing upon ancient geography. Proc. Amer. Philos. Soc., vol. 41, No. 171, pp. 267–400, figs. 1–8.

1905. The mutual affinities of the species of the genus *Cambarus*, and their dispersal over the United States. Proc. Amer. Philos. Soc., vol. 44, No. 180, pp. 91–136, pl. 3.

U. S. GOVERNMENT PRINTING OFFICE: 1940